DEPLOYING WIRELESS SENSOR NETWORKS WITH FAULT-TOLERANCE FOR ENERGY EFFICIENT CLUSTERING

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Abstract:

The most challenging aspect of WSN is that they are energy resource-constrained and that energy cannot be replenished. Clustering methods in WSN lead the sensor nodes to be organized into small disjoint groups, where each cluster has a coordinator referred as CH. Maintaining the created clusters is the main challenging task in the methods. To choose a node as a CH, it is necessary to define its eligibility. That is calculated based on local information of the nodes' current situations such as its residual energy. The eligibility of the selected CHs however, reduces as the sensor nodes are consuming energy for transferring data. However, there is possibility that the CHs may fail and function incorrectly due to a number of reasons such as power instability. During failure, the Cluster Heads cannot be able to collect and transfer data properly. So it affects the performance of the WSN. Early detection of failure of CHs will reduce the data loss and provide possible recovery efforts. This paper proposes a self-configurable clustering mechanism to detect the disordered Cluster Head node and replace them with other nodes.

Keywords: **Wireless Sensor, Cluster Head, Backup sensor, Dynamic Clustering, Repair Points.**

I. INTRODUCTION

A Wireless Sensor Network (WSN) consists of sensor nodes collecting information from the environment and communicating with each other via wireless transceivers. The collected data will be delivered to more sinks, generally via multi-hop communication. The sensor nodes are expected to operate with batteries and are deployed but not- easily-accessible or hostile environment. It is impossible to replace the batteries of the sensor nodes. On the other hand, the sink is rich in energy. Since the sensor energy is the precious resource in the WSN, efficient utilization of the energy to prolong the network lifetime has been the focus of much research on the WSN. The communication in WSN has the property of many-one so that, the data from a large number of sensor nodes tend to be engaged into a few sinks. Since multi-hop routing is generally needed for distant sensor nodes from the sinks to save energy, the nodes near a sink can be burdened with relaying a large amount of traffic from other nodes. Sensor nodes are resource constrained in term of energy, processor and memory and low range communication and bandwidth. Limited battery power is used to operate the sensor nodes and is very difficult to replace or recharge it, when the nodes die. This will affect the network performance. Lifetime of the network is increased by energy conservation and harvesting. Optimize the communication range and minimize the energy usage, we need to conserve the energy of sensor nodes .Sensor nodes are deployed to gather information and desired that all the nodes works continuously and transmit information as long as possible. This addresses the lifetime problem in wireless sensor networks. Sensor nodes spend their energy during transmitting the data, receiving and relaying packets. Hence, designing routing algorithms that maximize the life time until the first battery expires is an important consideration. Designing energy aware algorithms will increase the lifetime of sensor nodes. In some applications the network size is larger required scalable architectures. Energy conservation in wireless sensor networks has been the primary objective, but however, this constrain is not the only consideration for efficient working of wireless sensor networks. There are other objectives like scalable architecture, routing and latency. In most of the applications of wireless sensor networks are envisioned to handled critical scenarios where data retrieval time is critical, i.e., delivering information of each individual node as fast as possible to the base station becomes an important issue. It is important to guarantee that information can be successfully received to the base station the first time instead of being retransmitted.. In wireless sensor network data gathering and routing are challenging tasks due to their dynamic and unique properties. Many routing protocols are developed, but among those protocols cluster based routing protocols are energy efficient, scalable and prolong the network lifetime .In the event detection environment nodes are idle most of the time and active at the time when the event occur. Sensor nodes periodically send the gather information to the base station. Routing is an important issue in data gathering sensor network, while on the other hand sleep-wake synchronization is the key issues for event detection sensor networks.

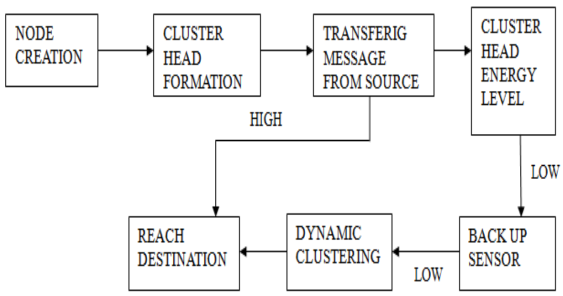


Figure 1. System Architecture

II. RELATED WORK:

In Design principles and improvement of cost function energy based aware routing algorithms for wireless sensor networks. We analyze the inherent factors, design principles and evaluation methods for cost based function routing algorithms. Two energy aware cost based routing algorithms named Exponential and Sine Cost Function based Route and Double Cost Function based Route has been proposed in this paper. Its cost function can map small changes in nodal remaining energy to large changes in the function value.

In sensor nodes have limited communication bandwidth processing power, and storage space. This gives rise to new and unique challenges in data management and information processing. In-network data processing International Journal of Computer Science Issues, such as data aggregation, multicast and broadcast need to be developed. Network lifetime is the key characteristics used for evaluating the performance of any sensor network. A lifetime energy network is determined by residual energy of the system, hence main and most important challenge in sensor node is the efficient use of energy resources. Literature shows the energy efficiency is introduced in sensor node using any of the following mechanisms: Power conservation mechanism, Energy conservation mechanism, Energy harvesting mechanism and Energy efficient routing. Energy aware routing The aim of routing in sensor node is to find out and maintain routes in sensor. Routing challenges with reference to sensor nodes are Energy consumption without losing accuracy, Node deployment, Link heterogeneity, Data reporting model, Network dynamic transmission media, Connectivity, Coverage, Data aggregation, Quality of services.

Hierarchical routing protocols are determined with more energy efficient when compared with flat and location based routing protocols. A number of hierarchical based energy efficient routing protocols have been referred to in the literature, Energy Efficient Position Based. The literature review refers to the fact that the main advantage of hierarchical approach is to control the data duplication and is best suited for data aggregation. According to this format, nodes are not allowed to communicate with the sink directly that they must go through a cluster head for communication purposes, while the cluster head collects the information from different nodes within a specific cluster area, and then it sends the collected data either to another cluster head or directly to the sink. This approach is more balanced and energy efficient compare to flat and location based routing protocols. However, the disadvantage of this approach is that it results in quick energy, drain of the cluster head nodes, most of the time they are involved in sending and receiving the data packets. Cluster heads rotation is possible but it also brings along an issue related to the loss of the energy resource.

In homogeneous sensor networks, all the sensor nodes and base stations are identical in terms of initial battery power and hardware capability. In this method, the static clustering elects cluster heads only once for the entire lifetime of the network. This results in over load on cluster heads .The role of cluster heads is randomly and periodically rotated over all the nodes to ensure the same rate of dissipation of battery power for all the sensor nodes.

The concept of cluster centre routing is exploited for the heterogeneous sensor network in the Energy Efficient Heterogeneous Clustered scheme to enhance the network lifetime. In this work, each and every weighted election probability for each node is calculated to decide the success of a node to be CH or not. For a hierarchical sensor node, the cluster head selection process is in a distributed way.

III. EXISTING SYSTEM

An energy-efficient location aware clone detection protocol in densely deployed sensor node, which can guarantee successful clone attack detection and maintain satisfactory network lifetime.We exploit the location information of sensors and select witnesses randomly which located in a ring area to verify the authority of sensors and to report detected clone attacks. The ring structure promote energy efficient information forwarding along the path towards the witnesses and the sink. The proposed protocol can achieve 100 per-cent clone detection probability with trustful witnesses .Further extend the work by studying the clone detection performance with unauthorised witnesses and show that the clone detection probability still approaches 98 percent when compromised to 10 percent of witnesses. Moreover, in most existing clone detection protocols with random witness selection scheme, the required buffer storage of sensors is usually dependent on the node density, O(n), while in our proposed protocol, the required intermediary storage of sensors is independent of n but a function of the hop length of the network radius. The simulations extensive demonstrate that our proposed protocol can achieve long network lifetime by effectively administer the traffic load across the network.

For restoring network connectivity in partitioned WSANs A number of arrangement have recently been designed. All of these schemes have focused on re-establishing severed links without considering the effect on the length of pre failure data paths. Some schemes recover the network by deviate the existing nodes, whereas others carefully place additional relay nodes. On the other hand, some work on sensor relocation focuses on metrics other than affinity, e.g., network longevity, coverage and asset safety, or to self-spread the nodes after non-uniform deployment.

Disadvantages:

Existing recovery schemes either impose high node relocation upper or extend some of the interrogator data paths.

Existing recovery schemes focused on re-establishing severed links without considering the effect on the length of pre failure data paths.

IV. PROPOSED SYSTEM

A Least-Disruptive topology Repair algorithm relies on the local view of a node about the network to devise a recovery plan that relocates the least number of nodes and ensures that no path between any pair of nodes is extended. Least-Disruptive is a localised and distributed algorithm that leverages existing route discovery activities in the network and imposes no additional pre failure communication overhead. The performance of Least-Disruptive is simulated using NS 2 simulator.

1. Topology Formation

Topology formation is an important issue in a wireless sensor network. Performance parameters such as energy utilization, network lifetime, data delivery delay, sensor field coverage depend on the network topology. Wireless sensor network mainly used for observing the events such as disaster deliberate in military surveillance. It can be placed in two different manners 1) Regular manner and 2) Irregular manner. Mostly in irregular manner we are deploying sensors irregularly and it is the chance for creating a holes in sensor networks. Battery depletion is the attack, it drained the energy of sensors. Each and every sensors can sense stated events in its sensing range, and broadcast with others in its transmission range.

a) Two-tier hierarchical cluster topology:

This is the most common structure for larger WSNs. In this topology, nodes within a distinct region send their data to a local cluster head. In turn all such cluster heads from different regions send their collected data to the destination. This network can be interlaced further also i.e. the cluster head of tier 2 can send the data to the cluster head of another network which can further send the data to the destination. The biggest advantage of this topology is that it divides the whole network into a number of small zones within which routing of signals can be done provincially. The cluster heads can be construct to be more powerful in terms of computation. In addition to it, the nodes can also be connected through a wire, which in-creases the transmission speed as well as reliability of the network.

2. Cluster Formation:

Cluster formation is the process of grouping the nodes in to a single is known as cluster formation. This cluster has n number of nodes those are having same attribute and also they are in the individual area. This group of single nodes forms the network. There are lot of clusters comes under a base station.

k-means clustering algorithm

k-means is one of the simplest unsupervised learning algorithms that solve the well known clustering problem. The procedure follows a simple and easy way to analyze a given data set through a assured number of clusters (assume k clusters) fixed apriori. The main idea is to define k center, one for each cluster. These center should be placed in a cunning way because of different location cause s different result. So, the better choice is to place them as much as possible far away from each other. The next step is to take each point association to a given data set and accomplice it to the nearest center. When no point is pending, the first step is completed and an early group age is done. We have these k new centroids, a new conclusive has to be done between the same data set points and the nearest new intermediate. A loop has been generated. As a result of this loop we may consider that the k intermediary change their location step by step until no more changes are done or in other words intermediate do not move any more. Finally, this algorithm aims at diminishing an objective function know as squared error function given by:

$$J(V) = \sum_{i=1}^{c} \sum_{j=1}^{c_i} \left(\left\| x_i - v_j \right\| \right)^2$$

a)Cluster Head Selection:

At the beginning, when clusters are being generated, each node choose whether or not to become a cluster head for each round as stated by the original LEACH protocol. Each self-selected cluster head, broadcasts an advertisement (ADV) message using non-persistent carrier sense various access (CSMA) protocol. The message contains the header identifier (ID).

b)Cluster Setup:

Each non-cluster head node chooses one of the strongest accepted signal strength (RSS) of the advertisement as its cluster head, and address a join-request (Join-REQ) message back to the chosen cluster head. The information about the node's capacity of being a concerted node, that is, its present energy status is combined into the message. If a cluster head accept the advertisement message from another cluster head y, and if the received RSS outstrip a threshold, it will point cluster head y as the neighbouring cluster head and it record ID. If the sink receives the announcement message, it will find the cluster head with the maximal RSS, and sends the sink-position directive to that cluster head marking it as the destination cluster head (TCH).

ALGORITHM:

Least-Disruptive topology Repair (LeDiR)

1. IF node J detects a failure of its neighbor F
2. IF neighbor F is a critical node
3. IF IsBestCandidate(J)
4. Notify_Children(J);
5. J moves to the Position of neighbor F;
6. Moved_Once<-TRUE;
7. Broadcast(Msg('RECOVERED'));
8. Exit;
9. END IF
10. END IF
11. ELSE IF J receives(a) notification message(s) from F
12. IF-Moved_Once||ReceivedMsg('RECOVERED')
13. Exit;
14. END IF
15. NewPosition<-Compute_newPosition(J);
16. IF NewPosition!=CurrentPosition(J)
17. Notify_Children(J);
18. J moves to NewPosition;
19. Moved_Once<-TRUE;
20. END IF
21. END IF

IsBestCandidate(J)

22. NeighborList[]<-GetNeighbors(F) by accessing column F in SRT;
23. SmallBlockSize<-Number of nodes in the network;
24. BestCandidate<-J;
25. FOR each node i in the NeighborList[]
    //use the SRT after excluding the failed node to find the set of
    // reachable nodes;
26. Number of reachable nodes<-0;
27. FOR each node k in SRT excluding i and F
28. Retrieve shortest path from i to k by using SRT;
29. IF the retrieved shortest path does not include node F
30. No. of reachable nodes<-No. of reachable nodes+1;
31. END IF
32. END FOR
33. IF Number of reachable nodes<Smallest Block Size
34. Smallest Block Size<- Number of reachable nodes;
35. BestCandidate<-i;
36. END IF
37. END FOR

38. IF BestCandidate –J
39.   Return TRUE;
40. ELSE
41.   Return FALSE;
42. END IF

3. Failure Detection

a) Route Discovery:

Route discovery is the process of selecting the route for the destination. It used R REQ and R REP for the route discovery process.In this process the R REQ is the broadcast message that is called as a route request. When the destination is identified, the destination sends the unicast R REP through the same path. This is used to find the best path between the source and destination.

b) Energy Drain:

After finding route, source can make communication with destination. For every data transmission and reception energy level will be decreased at initial energy level of node. Most Probably intermediate node energy can firstly dry due to trans-receiver characteristics. If its energy level is below 1 tends to node failure. It will not able to make communication with other's.

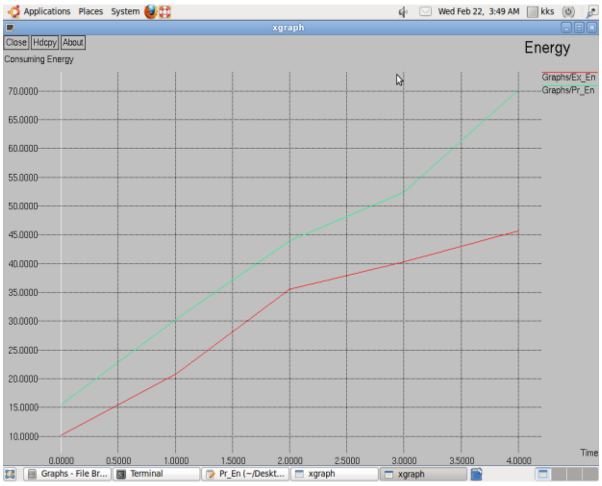


Figure 2. Energy Level Graph

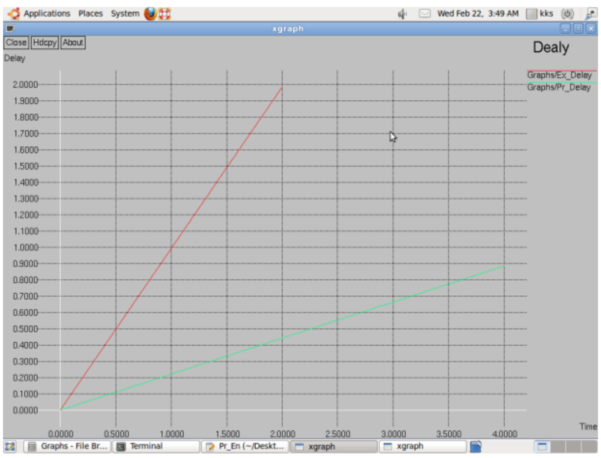


Figure 3. Delay graph

c) Border detection

We find a small or large disjoint block. Search and Place algorithm is distributed and light weight. The boundary nodes are detected by that are struct nodes, which will launch the hole discovery and the healing process even if these nodes are actually not stuck nodes. In order to differentiate the network border and hole border we are comparing coordinate value of nodes. In real wireless sensor network the node deployment is not uniform. So these networks contain some regions that are not covered by any sensor nodes, called holes. Topological hole and border detection methods are simple distributed approach to locate nodes near by the boundary of the sensor field and the hole boundaries. This method purely relay on the topology of the communication graph. Here the only information available is, whether the nodes can communicate with each other or not. The topological methods never use the any location information about the sensor nodes. The communication graph has node and edges if corresponding to wireless station can communicate with each other. If two nodes can communicate with each other then they come under a common communication radius.

4.Data Delivery

In order to construct an efficient system it is necessary to find a schedule that support the application requirements in terms of data delivery latency and reliability. The energy-related cost function for data delivery to sensor deployment data transmission. In this system improve the data transmission and improve the network lifetime using Backup sensor algorithm.

a)Backup Sensor Selection

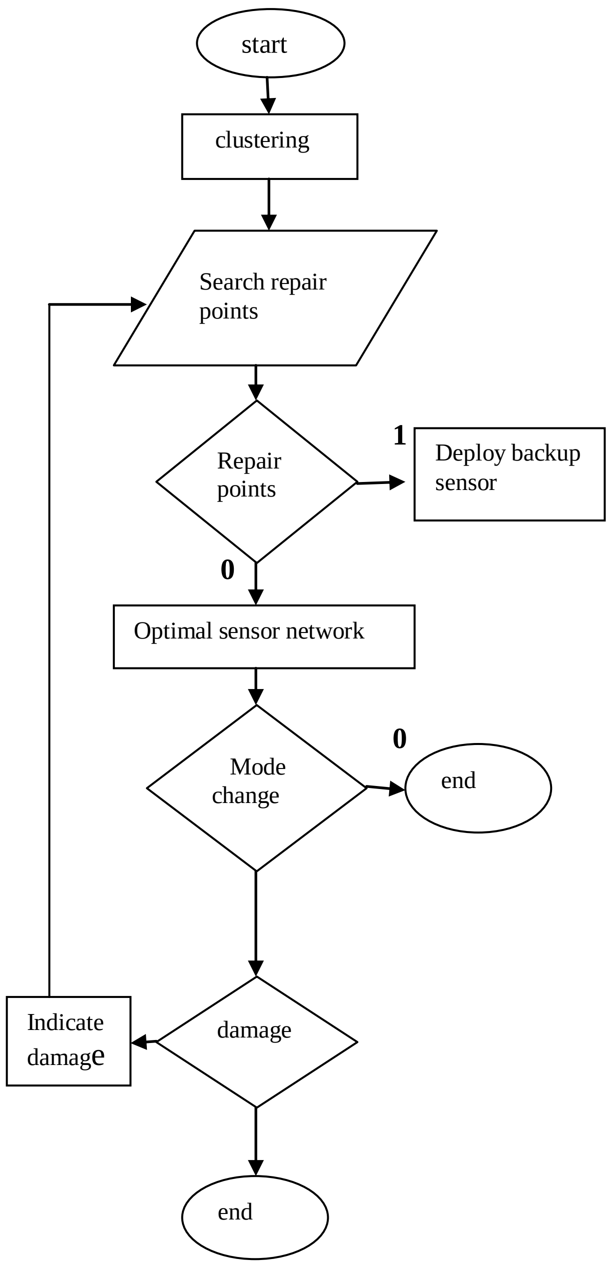
A middle point between two sensors and of a cluster is an Repair points (RP) which is with the longest and irregular transmission distance and the link between r 1 and r 2 is vulnerable. Find Critical midpoint, Search an place algorithm implement to place backup sensor in an network.The RP's identified are provided with the backup sensors of similar configuration as primary sensors. It improves the stability of the network by making system fault tolerant. The search for repair points runs continuously through all the clusters till all the RP's are provided with backup sensors.

Advantages:

- It is almost insensitive to the variation in the communication range.
- LEDIR also works very well in dense

networks and yields close to optimal performance even when nodes are partially aware of work topology.

FLOW CHART:



V EXPERIMENTAL RESULTS

The process of error debugging became more complicated with NS2, and it is considered to be a drawback with the use of this simulator, since there is a combination of two languages with this simulation.and it is considered to be a drawback with the use of this simulator, since there is a combination of two languages with this simulation.

Model Output:

- Nam window
- Xgraph.

1. NAM Window:

NS has a companion network animator called NAM hence, has been called the NS NAM

2. Xgraph:

One part of the NS-all none package is 'x-graph', a plotting program which is used to create graphic representation of simulation results.

VI CONCLUSION:

Wireless sensor and actor networks additionally employ actor nodes within the wireless sensor network which can process the sensed data and perform certain actions based on this collected data. In most of the applications, inter-actor coordination is required to provide the best response. This suggests that the employed actors should form and maintains a connected inter-actor network at all times.However, WSAN often operate unattended in harsh environments where actors can easily fail or get damaged. Such failures can partition the interacting network and thus eventually make the network useless. In such failures,we present a connected dominating set CDS based partition detection and recovery algorithm.The idea is to identify whether the failure of a node causes partitioning. If a partitioning is to occur, the algorithm designates one of the neighbouring nodes to initiate the connectivity restoration process. This process involves repositioning the set of actors in order to restore the connectivity. The overall goal in this restoration process is to localise the scope of the recovery and minimise the movement overhead imposed on the involved actors. This effectiveness of the approach is validated through simulation experiments.

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